THE MATURATION OF THE MOUSE EGG.

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Sobotta ('95) after careful study of a very large number of preparations of the egg and ovary of the white mouse came to the conclusion that in nine tenths of these eggs the maturation processes involve the suppression of the first polar spindle, and the formation of only a single polar body. Gerlach ('06), after a study of preparations made at least as early as 1890, has revived Tafani's theory that in the majority of mouse eggs the second polar body is suppressed. Gerlach's conclusion is that when a spermatozoön enters an egg sometime after it has formed the second polar spindle, the second polar body fails to develop, and the spindle degenerates within the egg.

These results are at variance with the majority of opinions reached, before and since, by investigators of the eggs of other animals, vertebrate and invertebrate, and a reinvestigation of the maturation processes in the egg of the white mouse has brought it into line with most other metazoön eggs.

Material and Method. — The mice used have been killed during the period of most active breeding, namely, April, May, June and September, and serial sections made of the ovaries and Fallopian tubes. Ovulation, during the spring months, occurs very soon after parturition, independent of copulation, as observed by Rübaschkin ('05) in the guinea-pig.

When observed to be pregnant, the females were mated, and killed, some a few days or hours before parturition, others during that process, and still others at intervals from a few minutes to thirty hours after giving birth to a litter. The tissues were killed with a variety of the more generally used cytological fluids, and the following is a brief summary of the results obtained: All the ovaries contained some eggs with the second polar spindle and accompanied by the first polar body, and a majority of the series revealed ovarian eggs at the end of the spireme or with the first polar spindle. The eggs observed in the Fallopian tube fall into two main groups: those which had not been fertilized, and

therefore retained the second polar spindle — some being accompanied by the first polar body, more without it — and those which had been fertilized. The latter included stages from the entrance of the spermatozoön through the cleavage stages.

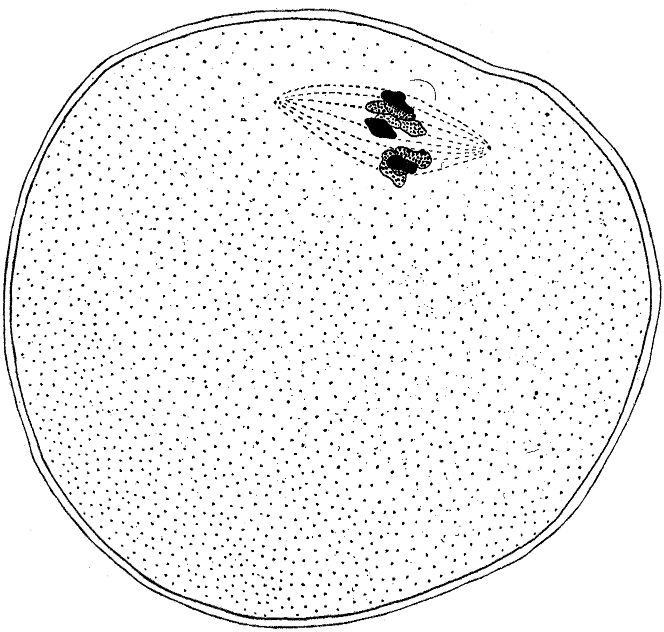

FIG. 1. Ovarian egg showing first polar spindle. Zona pellucida represented by double line. $\times$ 1200.

First Polar Spindle (Fig. 1). — The preparations in which there are stages immediately preceding the formation of the first polar spindle have not been fully studied, but there is evidence of a precocious division, the number of chromatin masses being between twelve and twenty-four.

The first polar spindle when first formed lies with its axis perpendicular to the radius of the egg, as found by Rubaschkin ('05) in the egg of the guinea-pig, and later one pole swings somewhat toward the center of the egg. The chromosomes of the first polar spindle are short and thick (Fig 2), and vary greatly in size. The spindle fibers come to more or less of a focus, and centrioles have often been seen at the poles of this spindle, where they are made up of several distinct, eccentrically placed granules.

First Polar Body (Figs. 3 and 5). — The study of many preparations reveals the following facts: None of the eggs in the Fallopian tube have failed to develop at least to the formation of the second polar spindle, and all the ovarian eggs which by their size, slightly denser protoplasm and large follicles appear to be nearly ripe, have already extruded the first polar body. The conclusion arrived at is, that apparently every egg which is capable of further development forms a first polar body within the ovary. This agrees with the observations of Rubaschkin ('05) upon the guinea-pig egg, and those of Van der Stricht ('01) upon the egg of a bat, *Vesperugo noctula*.

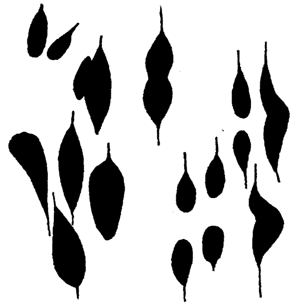

FIG. 2. Diagram of chromosomes in first polar spindle. Note great variation in size. Four more chromatin masses in adjacent sections.

This point established, it is next necessary to explain the disappearance of the first polar body in the majority of eggs seen in the Fallopian tube. The zona pellucida may persist in the mouse egg, undiminished, through the early cleavage stages, but in the majority of instances during the process of ovulation the first polar body is either forced through a weakened part of the zona, or frees itself by amœboid movements, and comes to lie outside the zona, as described and figured by Van der Stricht ('04).

The first polar body is usually oval in form, and is characterized, as found by Van der Stricht ('04) in the egg of *V. noctula*, by often possessing a little maturation spindle of its own, and in other instances having its chromosomes scattered. In some of these cases which possess a spindle, the first polar body would probably have divided mitotically, as observed by Sobotta ('95) in the mouse egg, and once by Rubaschkin ('05) in the egg of the guinea-pig. The polar bodies vary somewhat in size, and in one series of ovarian eggs there have been found first polar bodies of about four times the average volume. The number of chromosomes in the first polar body is twelve (dyads).

Second Polar Spindle (Fig. 3). — Immediately after the formation of the first polar body, the twelve dyads remaining in the

egg are drawn into the equator of a new spindle, split longitudinally, and the twenty-four daughter, univalent chromosomes

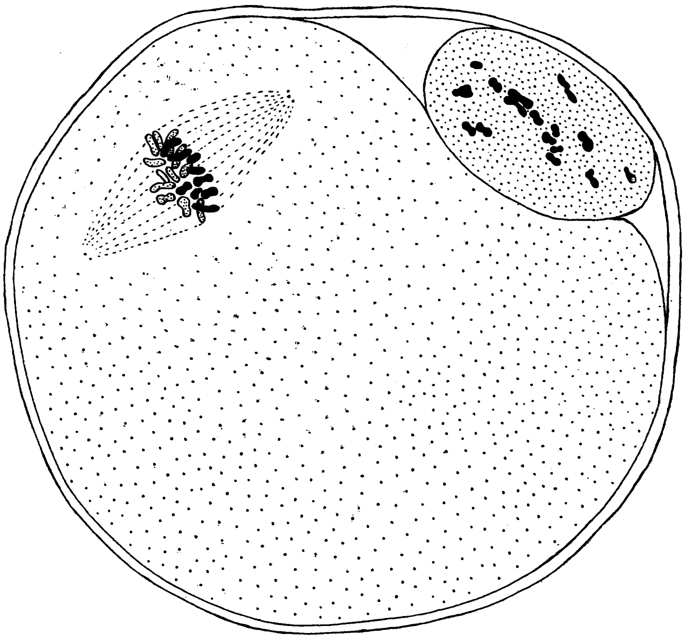

FIG. 3. Ovarian egg showing first polar body and second polar spindle. Seventeen masses of chromatin, some of which are undivided dyads, are scattered through the first polar body; twenty-four univalent chromosomes appear in the equator of the second polar spindle. Certain chromosomes have been added from adjacent sections. A minute centriole appears at each pole of the second spindle. The zona pellucida is represented by a double line. × 1200.

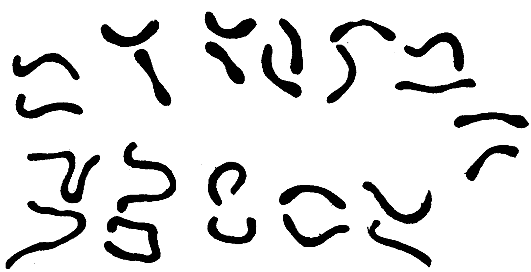

FIG. 4. Diagram of univalent chromosomes in second polar spindle, indicating difference in size.

lengthen out into filaments of various sizes (Fig. 4). Like the first polar spindle the second varies in size, and lies with its axis at

right angles to the radius of the egg, usually near the first polar body. Centrioles, similar to those described above for the first polar spindle, have frequently been observed in second polar spindles, and in some cases a few radiating aster fibers have been seen at the poles. In attempting to determine whether a given polar spindle is first or second, the character of the chromatin has always been found a positive guide.

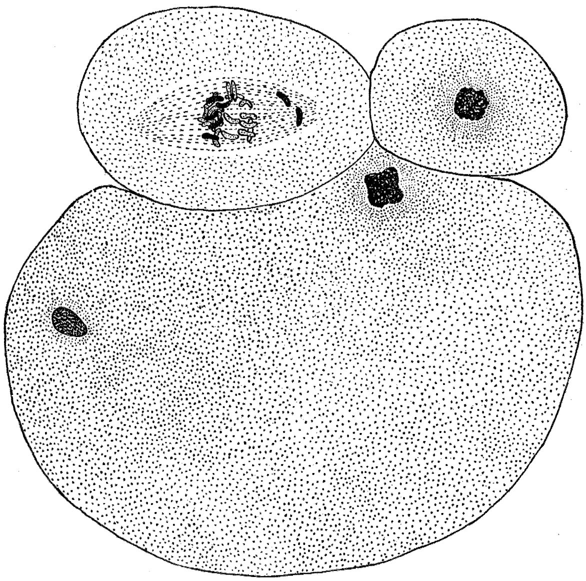

FIG. 5. Egg in Fallopian tube showing both polar bodies. Note spindle in first polar body. The sperm head appears at left, the female pronucleus at right, in the egg. × 1200.

Mature eggs which are retained within the ovary, together with such as are discharged and fail to be fertilized, degenerate with the second polar spindle, as found by Rubaschkin ('05) in the case of the guinea-pig egg.

Second Polar Body (Figs. 5 and 6). — Only one spermatozoön enters an egg, and it carries in most, if not all of its tail, a fact observed by Van der Stricht ('04) in the egg of *V. noctula*. When fertilized the egg at once forms its second polar body. This is more or less nearly spherical, smaller than the first polar body, and, as stated by Van der Stricht ('04) for *V. noctula*, generally

has its chromosomes gathered into a single compact mass. It quickly forms a resting nucleus, possessing compact masses of chromatin, and is usually the only polar body seen during the early cleavage stages. In one instance (Fig. 6.) a second polar body was observed which had just been constricted off, and in consequence showed the separate chromosomes, twelve in num-

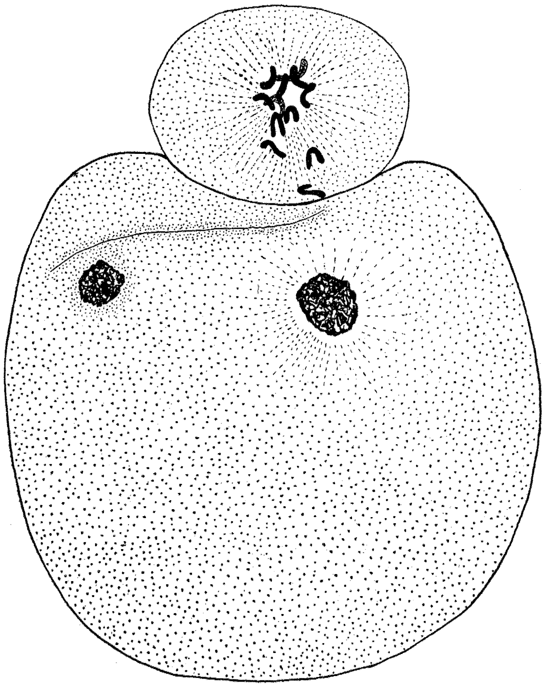

FIG. 6. Egg in Fallopian tube showing second polar body. First polar body has disappeared. At left in the egg is seen the sperm nucleus, and above it the separated tail of the spermatozoön ; at right appears the egg nucleus, surrounded by delicate radiating fibers. × 1200.

ber, and another preparation showed the second polar body forming the resting nucleus.

The mouse egg is thus shown to be no exception to the general rule, that the maturation process in the metazoön egg involves the formation of two polar bodies.

In closing, I desire to express my gratitude, and great indebtedness to Professor Wesley R. Coe for his constant oversight and encouragement.

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